EXPERIMENTAL FARM

LACOMBE, ALBERTA

PROGRESS REPORT
1953-1957

EXPERIMENTAL FARMS SERVICE
CANADA DEPARTMENT OF AGRICULTURE
OTTAWA, ONTARIO

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TECHNICAL STAFF

Administration

G. E. DeLong, B.S.A., M.Sc. ..... Superintendent
(Retired Nov., 1955)
J. G. Stothart, B.S.A., M.Sc. ..... Superintendent
(Appointed Nov., 1955)

Animal Husbandry

H. T. Fredeen, B.S.A., M.Sc., Ph.D. ..... Sr. Animal Husbandman
G. H. Bowman, B.S.A., M.Sc. ..... Animal Husbandman
J. A. Newman, B.Sc. ..... Animal Husbandman
H. Doornenbal, B.Sc., M.Sc. ..... Animal Husbandman

C

..... Senior Agronomist
..... Agronomist

Fi ring

..... Senior Agronomist
..... Agronomist (Soils)
..... Agricultural Engineer

Fc

..... Senior Agronomist

..... Agronomist

Hc

..... Horticulturist

Ill

..... Supervisor
..... Supervisor

Ex il Research)

..... Officer-in-Charge

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Progress Report, 1953-1957
Experimental Farm, Lacombe, Alberta

INTRODUCTION

Established in 1907 the Lacombe Experimental Farm celebrated its 50th anniversary on July 31, 1957. A brief review of the work accomplished since its establishment was published at that time. The last detailed progress report covered the period 1947-52 and the current report deals with the research work for the period 1953-57 inclusive.

While the primary purpose of the program at Lacombe is to investigate methods, treatments, and procedures to promote the agriculture of central Alberta, the ever increasing emphasis on more basic research has resulted in findings that have a much broader application.

Indicative of such work was the release across Canada in 1957 of 50 boars of a new breed of bacon hogs. This development was the result of the application of new breeding and selection techniques developed at Lacombe. The detailed fertilizer and chemical herbicide experiments, the breeding of resistant red clovers, the pasture investigations, and the search for selection indexes for yield to be used in early generations of cereal crop breeding are other examples of work in progress at Lacombe of far-reaching importance.

Off-station research is conducted on Illustration Stations located on soil and in climatic zones differing from the main Farm and representative of sections of the very large area served by Lacombe. These are located at Athabasca, St. Paul, Fort Kent, Evansburg, Metiskow, Castor, Chedderville, Leslieville, and Acme. Work at Ryley was discontinued in 1954 and at Chauvin in 1957.

In 1955 an experimental substation was established at Vegreville under the supervision of Lacombe, to investigate the problem of production on solonetzic soils. Dr. R. R. Cairns was appointed in 1957 to direct the research work at this location.

There were a number of changes in staff during the period under review. G. E. DeLong, agronomist from 1921 to 1946 and superintendent from 1946 to 1955, retired and J. G. Stothart, senior animal husbandman, was appointed Superintendent. H. W. Leggett, head of the Field Husbandry, Soils and Agricultural Engineering Section was appointed superintendent of the Regina Experimental Farm in 1953 and was succeeded by H. A. Friesen on transfer from the Experimental Farm, Scott, Saskatchewan. S. R. Church was appointed to the Illustration Stations Section in 1953 to fill the vacancy created by the resignation of A. W. Wilton, and Dr. M. L. Kaufmann to the Cereal Crops Section in 1955 replacing E. C. Lowe, who accepted a position with the Alberta Department of Agriculture. Dr. H. T. Fredeen became head of the Animal Husbandry and Poultry Section when J. G. Stothart was made superintendent in 1955 and H. Doornenbal was appointed in 1956 to fill the vacancy created by this promotion.

Additions to the staff during the period were: W. J. Doran, Forage Crops 1953; J. A. Newman, Animal Husbandry 1955; and D. A. Dew, Field Husbandry (Agricultural Engineering) 1956.

The Experimental Farms Service lost an outstanding research officer in the tragic death on April 1, 1957 of H. B. Stelfox, head of the Forage Crops Section, Lacombe, following an automobile accident.

TABLE 1.—PRECIPITATION RECORDS

Monthly and Annual Precipitation Records (inches) 1953–1957 inclusive with 50–year averages and monthly extremes

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Annual		
													Snow*	Rain	Precip.
1953	1.39	0.74	1.11	1.69	2.82	4.62	3.91	3.34	0.81	0.11	0.05	0.49	42.9	16.79	21.08
1954	0.54	0.36	1.16	1.12	3.25	3.87	1.71	7.47	1.21	0.34	0.26	0.24	38.1	17.72	21.53
1955	0.59	0.52	2.34	2.72	1.74	2.57	3.21	0.80	3.55	0.98	0.37	1.32	92.3	11.48	20.71
1956	0.73	1.25	1.72	0.93	0.30	5.30	2.63	2.84	1.37	0.73	0.51	1.57	67.0	13.18	19.88
1957	1.10	0.62	0.43	1.19	1.11	2.47	1.20	2.34	0.99	1.96	0.67	0.25	48.0	9.53	14.33
5–year average	0.87	0.70	1.35	1.53	1.84	3.77	2.53	3.36	1.59	0.82	0.37	0.77	57.7	13.74	19.51
50–year average	0.71	0.72	0.83	0.31	1.98	3.38	2.87	2.52	1.54	0.81	0.64	0.67	43.52	13.65	17.98
Lowest monthly precipitation for 50–year period	0.02	0.00	0.13	0.04	0.30	0.82	0.63	0.29	0.13	0.00	0.00	0.00	10.8	7.19	12.73
Year	1931	1931	1912	1910	1956	1924	1929	1939	1918	1921 and 1944	1908 1917 and 1941	1913 and 1915	1915	1929	1920
Highest monthly precipitation for the 50–year period	1.53	2.80	2.34	4.61	4.37	8.11	6.13	7.47	3.55	2.66	2.13	2.80	92.3	21.37	25.21
Year	1913	1948	1955	1948	1944	1931	1944	1954	1955	1924	1927	1924	1955	1944	1927

* 10 inches of snow equals 1 inch of water.

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TABLE 2.—FROST RECORDS

Frost 32°F. or lower, killing frost 28°F. or lower

Year	Last spring frost		First fall frost		No. of frost-free days	Last killing spring frost		First killing fall frost		No. of killing frost-free days
	Date	Temp.	Date	Temp.		Date	Temp.	Date	Temp.	
1953	May 24	26	Sept. 26	27	125	May 24	26	Sept. 26	27	125
1954	May 29	31	Sept. 20	24	114	May 3	25	Sept. 20	24	140
1955	May 24	32	Sept. 9	30	108	May 7	27	Sept. 10	22	126
1956	May 30	30	Sept. 4	31	97	May 13	27	Sept. 27	28	137
1957	May 22	26	Aug. 27	31	97	May 22	26	Sept. 18	18	119
5-year average	May 26	.....	Sept. 11	.....	108	May 14	.....	Sept. 20	.....	129
50-year average	June 7	.....	Aug. 29	.....	83	May 19	.....	Sept. 14	.....	118
Shortest crop season	July 3, 1919	32	Aug. 15, 1919	32	42	June 13, 1920	27	Sept. 13, 1920	25	92
Longest crop season	May 4, 1940	29	Sept. 19, 1940	30	138	Apr. 17, 1940	28	Sept. 24, 1940	28	160
Earliest frost dates	May 4, 1940	29	July 25, 1913	32	.....	Apr. 17, 1940	28	Aug. 21, 1908	26	
Latest frost dates	July 13, 1920	32	Sept. 26, 1953	27	.....	June 23, 1924	27	Oct. 9, 1930	26	

TABLE 3.—METEOROLOGICAL RECORDS 1953–1957

Experimental Farm, Lacombe, Alberta

Month	Temperatures						Wind speed M.P.H.			Hours sunshine		Evaporation		
	Mean		Mean maximum		Mean minimum		1953–57	No. Years averaged	Av.	1953–1957	Average 50 Years	1953–57	No. Years averaged	Average
	1953–57	Average 50 Years	1953–57	Average 50 Years	1953–57	Average 50 Years								
January	3.2	6.8	12.9	18.9	−6.4	−5.4	5.8	29	5.2	79.4	83.4			
February	14.8	12.1	25.8	25.2	3.8	−1.0	6.5	30	5.3	122.9	120.6			
March	19.1	22.6	30.9	35.2	9.8	1.6	6.6	30	6.0	149.6	161.7			
April	33.5	38.3	43.5	53.2	23.4	25.3	7.2	30	6.9	182.5	202.9		14	1.09
May	49.4	49.5	61.6	63.3	37.2	35.8	7.5	30	7.2	250.5	241.0		20	3.35
June	55.6	55.1	67.6	67.7	43.8	42.9	6.9	31	6.5	240.9	250.3	4.53	25	3.43
July	61.2	61.3	73.6	75.4	48.8	47.2	5.8	29	6.0	300.7	397.6	5.92	26	4.27
August	58.3	58.4	70.1	72.9	46.4	43.9	5.2	27	5.4	244.9	261.8	4.55	26	3.60
September	50.2	50.0	62.7	64.3	39.0	35.8	6.2	29	6.1	178.5	184.0		22	2.04
October	39.3	39.9	52.8	54.0	25.8	25.8	6.4	29	6.2	176.7	152.0		16	0.78
November	30.9	24.9	37.0	36.7	17.0	13.0	6.0	29	5.6	112.5	99.2			
December	15.6	13.2	25.9	24.7	5.3	1.8	5.9	29	5.7	83.4	76.4			

ANIMAL HUSBANDRY AND POULTRY

H. T. FREDEEN (HEAD), G. H. BOWMAN, J. A. NEWMAN, AND H. DOORNENBAL

The major portion of the livestock work at Lacombe is devoted to animal breeding research with swine and beef cattle. Nutritional studies and carcass analyses are also conducted with swine and a large-scale pasture research project is under way in co-operation with the Field Husbandry and Forage Crops sections. A horse stud with three stallions was maintained to the end of 1957 as a public service.

Cattle

Performance testing: Research at Lacombe has been directed toward the evaluation of a method for performance testing of beef cattle, and is part of a co-operative study with the Experimental Farms at Scott, Indian Head, and Brandon.

That progress may be forthcoming from selection based on performance has been illustrated by a preliminary breeding study in which two half-sib bulls of distinctly different feed-lot performance (average daily gains of 2.46 and 1.71 pounds) were assigned to representative cow herds. The performance of the resulting progeny (table 4) shows a slightly higher feed-lot gain for the progeny of the high performing sire; this superiority coupled with distinctly heavier weaning weights combined to provide a superiority in age at finish of 37 days for each sex.

TABLE 4.—COMPARATIVE PERFORMANCE OF PROGENY FROM A HIGH GAINING AND A LOW GAINING SIRE

Performance Trait	Average performance					
	Low gaining line			High gaining line		
	Sire	Progeny		Sire	Progeny	
		M	F		M	F
Number of calves born	—	13	8	—	10	12
Birth weight (pounds)	66.0	71.8	65.6	77.0	75.1	66.8
Number of calves weaned	—	13	8	—	9	9
Weaning weight (pounds)*	334	322	269	375	356	314
Number of calves tested	—	13	6	—	8	9
Average daily gain (lb.)**	1.71	1.96	1.40	2.46	2.05	1.44
Feed required per 100 lb. gain**	849	721	894	572	697	875
Age at finish **	392	411	467	317	374	430

* Calves are weaned at 140 days of age.

** Evaluation of bulls is based on performance from 500 to 800 pounds, and of heifers on performance from 450 to 700 pounds.

Pasture research: The productivity of creeping red fescue, brome, and a brome–alfalfa mixture at three levels of fertility has been measured by the grazing of yearling steers. Cost of fertilization has been more than offset by increases in beef production from the fertilized plots. Steers on brome and brome–alfalfa have excelled in average daily gains while fescue has proved superior in total carrying capacity. Pounds of beef per acre has tended to be similar on all three swards.

Swine

Investigations with swine have included breeding and selection studies, evaluation of methods for measuring certain carcass traits, and study of some of the factors that must be considered in the genetic interpretation of swine performance data.

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Radiography in swine research

Radiographic techniques have been devised for the measurement of back fat and vertebral size in the living pig at 200 pounds weight. Data are being collected to examine the repeatability of such measurements and their value in predicting actual carcass measurements. This research may provide methods for evaluating the carcass potential of the live bacon hog. This would permit selection for carcass quality on the basis of the individual pig rather than on the basis of the average of slaughtered sibs.

Radiography has also been used to determine the rib and vertebral counts of approximately 3,000 pigs. Number of rib pairs was found to vary from 14 to 17, and total number of presacral vertebrae varied from 27 to 30. The most frequent values were 16 pair of ribs (54 per cent) and 29 vertebrae (64 per cent). Genetic studies of these differences have not been completed.

Influence of sex on carcass quality

A study co-operative with Production Service involving 692 Yorkshire litter groups of two barrows and two gilts each, tested under the Canadian Record of Performance for Purebred Swine, substantiated the important sex differences in carcass quality previously reported from this station. The magnitude of sex differences in carcass measurements was relatively constant at all levels of litter performance with gilts at 200 pounds being .25 inch longer, carrying approximately one tenth inch less fat along the back and possessing a loin area .55 square inches greater than barrows at the same weight. These differences are of sufficient importance to require recognition in the interpretation of results from nutritional experiments, litter tests concerned with swine breeding research, or litter tests related to a standard performance test. Results of this study emphasize the need for separate carcass scoring standards for males and females.

Influence of carcass testing on genetic improvement of swine

Swine breeding programs that emphasize improvement of carcass quality generally rely on some form of slaughter test to provide the requisite slaughter information. The reliability of the carcass data thus obtained is proportional to the number of pigs slaughtered from a given litter. However, the intensity of selection that may be practiced among the surviving litter mates is inversely proportional to the number slaughtered.

A theoretical study of this problem has demonstrated that, under average conditions of herd and litter size, maximum genetic improvement for carcass traits is likely to be realized when the test group comprises males only and a minimum of two and a maximum of three pigs are slaughtered. Where the test is employed as a sib-test there would appear to be no circumstances under which the testing of two males and two females from a litter could permit as rapid a rate of genetic gain as the testing of three males. This conclusion does not necessarily apply to the case where the test is employed as a progeny test or to the situation where accuracy of the test is of paramount importance.

Heritability of carcass traits in swine

Data supplied by Production Service from more than 12,000 pigs tested under Advanced Registry were analyzed to provide estimates of the genetic parameters associated with several important performance traits, (Table 6). The heritability estimates are reasonably large and encourage the view that selection for improved carcass quality should be successful. The important genetic correlations are generally positive as regards merit indicating that genetic gain for each trait should be enhanced in a program of simultaneous selection.

TABLE 6.—ESTIMATES OF HERITABILITIES (LEADING DIAGONAL), PHENOTYPIC CORRELATIONS (ABOVE DIAGONAL) AND GENETIC CORRELATIONS (BELOW DIAGONAL) FOR CERTAIN PERFORMANCE TRAITS IN THE CANADIAN YORKSHIRE*

	Age	Length	Shoulder fat	Back fat	Loin fat	% ham	Loin area	Feed economy
Age at 200 lb. live wt. (days)	**.55**	−.10	−.01	−.08	−.02	.09	.09	.51
Length of carcass (inches)	−.15	**.40**	−.22	−.27	−.20	−.14	−.07	−.04
Thickness of shoulder fat (inches)	.13	−.17	**.42**	.50	.53	−.28	−.19	−.00
Back fat (inches)	−.05	−.27	.65	**.38**	−.62	−.26	−.12	−.02
Loin fat (inches)	−.01	−.11	.67	.74	**.48**	−.25	−.21	−.02
Percentage ham	.09	−.22	−.40	−.36	−.31	**.50**	.25	−.05
Loin area (sq. in.)	.10	−.17	−.16	−.08	−.19	.19	**.66**	−.04
Feed economy (feed/gain)	.37	.02	.03	−.01	.00	−.09	−.13	**.30**

* Phenotypic correlations greater than .03 in absolute magnitude are highly significant.

Role of individual feeding of pigs under performance test

An intensive analysis has been completed of data from the progeny testing program for swine in Denmark. These data, made available through permission of the National Research Institute for Animal Husbandry, Copenhagen, Denmark, were compiled under a system of individual feeding of the test pigs. Similar data are not available in Canada where litters on performance test are fed as groups rather than individually. Estimates of the various parameters, computed separately for each sex are given in Table 7.

TABLE 7.—HERITABILITIES (LEADING DIAGONALS), PHENOTYPIC CORRELATIONS (ABOVE DIAGONALS), AND GENETIC CORRELATIONS (BELOW DIAGONALS) FOR CERTAIN PERFORMANCE TRAITS IN THE DANISH LANDRACE; SEXES SEPARATE*

	Males				Females			
	Length	Feed efficiency	Daily gain	Back fat	Length	Feed efficiency	Daily gain	Back fat
Length	**.48**	−.02	−.00	−.24	**.48**	−.04	−.00	−.24
Feed efficiency	−.18	**.72**	−.84	+.31	−.02	**.45**	−.84	+.14
Daily gain	+.09	−.96	**.66**	−.20	+.08	−.87	**.35**	−.06
Back fat	−.47	+.28	−.19	**.52**	−.32	+.16	−.17	**.58**
Standard errors of heritabilities	.106	.114	.112	.115	.114	.112	.107	.115

* Phenotypic correlations greater than .08 in absolute magnitude are highly significant.

The estimates obtained for the heritability of carcass length and back fat are similar to those reported for the Canadian Yorkshire while those for average daily gain and feed efficiency are larger than previously reported for swine. The latter is assumed to reflect the increased accuracy with which genetic differences in feeding ability may be measured under a system of individual feeding. Additional information is required before the large and important sex differences in the heritability of feed efficiency and average daily gain can be adequately interpreted.

Breeding Research

Development of new breeds from hybrid foundations

Two hybrid foundations were established in 1947, one being discarded in 1953 and the other officially recognized as a new breed in 1957.

Minnesota No. 1 × Landrace-Chester Line: Minnesota No. 1 pigs, brought to Lacombe in 1947, were crossed with the Landrace-Chester to provide material

for the development of one hybrid foundation. Performance of this cross was disappointing. Litter size at birth was small, and susceptibility to disease to which the native Yorkshire appeared resistant markedly reduced litter survival. Carcass length was satisfactory but heavy back fat and inferior lean content of the carcass were characteristic of this hybrid foundation. These same weaknesses were observed in the purebred Minnesota No. 1 litters produced at Lacombe and all of the foundation material was discarded in 1953.

Berkshire × *Landrace-Chester Foundation.*—Research with this hybrid foundation commenced in 1947 and was climaxed in 1957 by official recognition of the new breed and the Canada-wide distribution of 50 boars. Named the "Lacombe" in 1955 this new breed was accepted for registration by Canadian National Livestock records in November, 1957.

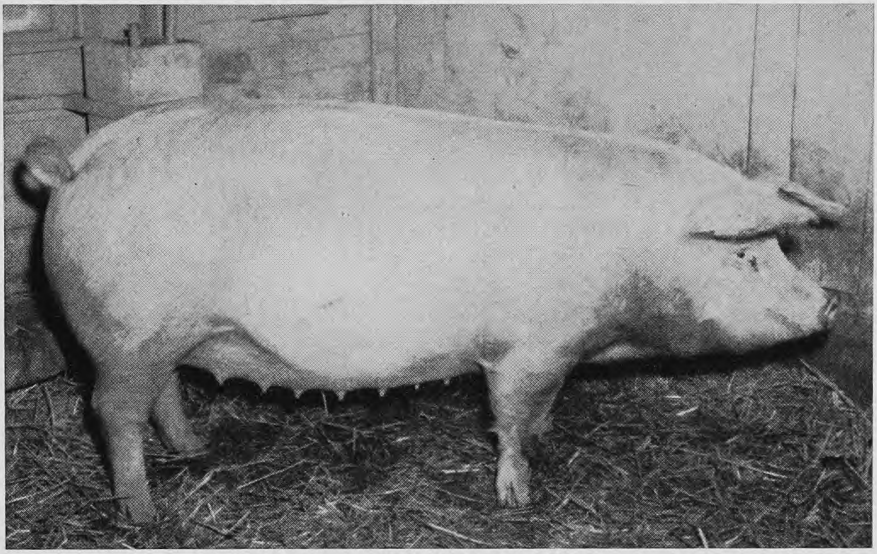

Figure 2—A Lacombe gilt.

During the first four years of the ten required to produce this new breed the desired characteristics of the three parent breeds were integrated in a hybrid foundation. The herd was closed in 1951 and subsequent matings were made inter-se using a minimum of 20 boars in each generation to minimize inbreeding. Contemporary Yorkshire and Lacombe-Yorkshire crossbred litters were farrowed and tested in each generation to provide desired comparative information.

Selection throughout the development of the breed was based on factors influencing economic production. Pigs chosen for breeding were required to be vigorous, growthy, and physically sound. In addition their sibs must have excelled in carcass quality, rate of growth, and feed efficiency as measured by performance test. Attention was also given to teating with 14 normal teats being the minimum requirement for both sexes.

The data of Table 8 show the comparative performance of contemporary Lacombe and Yorkshire litters. The Lacombe appears to excell in both pre- and post-weaning growth. The data of Table 9 provide an evaluation of the top-cross performance of Lacombe boars on grade and purebred Yorkshire sows. These results indicate that the Lacombe crosses well with the Yorkshire to produce a highly acceptable commercial pig exhibiting hybrid vigor for growth.

TABLE 8.—COMPARATIVE PERFORMANCE OF THE LACOMBE AND YORKSHIRE BREEDS AT THE LACOMBE EXPERIMENTAL FARM. SOW LITTERS ONLY

Breed	Number alive		Weight at		Age to market days	% A Grades	A. R. Score
	birth	weaning	birth lb.	weaning lb.			
Lacombe	10.5	8.3	3.1	39.9	172	78	78.4
Yorkshire	9.9	8.0	2.5	34.0	189	82	82.9

TABLE 9.—PERCENTAGE ADVANTAGE OF LACOMBE×YORKSHIRE OVER CONTEMPORARY YORKSHIRES IN GRADE COMMERCIAL HERDS AND IN THE UNIVERSITY OF ALBERTA PUREBRED YORKSHIRE HERD

Herds	Number alive		Weight at		Rate of Gain to Market %	No. of A Grade Carcasses %
	Birth %	Weaning %	Birth %	Weaning %		
Commercial	−0.4	−0.3	*	11	7	15
U. of A.	4.0	4.0	26	22	11	13

* Data not available.

Selective registration embodying minimum standards for carcass quality, feed efficiency and rate of growth has been officially adopted for the Lacombe breed. This feature makes performance testing a requisite to registration. Genetic purity for white color has been established by culling all Lacombe breeding stock that proved heterozygous for white when backcrossed to purebred Berkshires.

Poultry

During the period 1946 to 1954 the entire facilities for poultry research at Lacombe were devoted to a study of the inheritance of fertility and hatchability. Two breeds, the White Wyandotte with low fertility and the New Hampshire with high fertility, were maintained for these investigations. Present investigations concern the rate of genetic gain obtainable under a system of pullet and cockerel selection based entirely on part-year records. Allied with this is a detailed study of the genetic inter-dependence between egg production and egg quality .

Reproductive studies.—Reciprocal crosses between the White Wyandotte and the New Hampshire indicated that the low reproductive rate of the former breed resulted from inferior fertility of the White Wyandotte male. This conclusion was substantiated by subsequent results from artificial insemination which revealed that the life of White Wyandotte sperm in the reproductive tract of either breed of female was approximately 25 per cent shorter than the life of New Hampshire sperm under contemporary conditions. Concurrent studies indicated some striking physiological differences between the two breeds. White Wyandotte chicks fed iodinated casein (protamone) at 0.02 per cent of the ration continuously from hatching suffered high mortality during the first two weeks of life. This was not observed with contemporary New Hampshires. This was interpreted as a basic difference in thyroid function of the two breeds. Body weight at six months of age showed no statistically significant differences between the breed-treatment sub-groups, but the feeding of protamone depressed thyroid development in both breeds and accelerated

gonad development, particularly in the White Wyandotte. These results are shown in the following table which also illustrates the basic breed difference in gonad size.

TABLE 10.—BODY AND ORGAN WEIGHTS AT SIX MONTHS OF AGE FOR CONTROL AND PROTAMONE-FED NEW HAMPSHIRE AND WHITE WYANDOTTES

	Body Weight (grams)	Gonad Weight (grams)	Thyroid Weight (grams)
W. W. Control	2973	6.05	.203
W. W. Protamone	2789	10.85	.054
N. H. Control	3004	18.14	.263
N. H. Protamone	2916	19.38	.062

The accelerated gonad development of the protamone-fed White Wyandotte male was not consistently related to improved reproductive performance as measured by duration of fertility following artificial insemination. However the continuous feeding of protamone to the females had an adverse effect on the hatchability of fertile eggs with eggs from the protamone-fed White Wyandotte females showing the greatest embryonic mortality. Additionally, the eggs from protamone-fed females required 12 to 18 hours longer incubation than eggs from the control females. A separate experiment demonstrated that cockerels fed a ration containing 0.02 per cent protamone during the breeding season produced sperm with an increased duration of viability in the reproductive tract of the female. This effect, while apparent in both breeds, was most pronounced in the White Wyandotte.

CEREAL CROPS

A. D. McFadden and M. L. Kaufman

Cereal crop research at Lacombe features breeding programs designed to develop improved varieties of wheat, oats, and barley. Because the growing season throughout most of central Alberta is relatively short, earliness and high yield have been the prime objectives. Scald and loose smut of barley and bunt of wheat are important diseases to the area and resistance to these is sought through breeding. Progress on these projects will be reported under the main heading "Breeding and Selection".

Extensive testing of varieties of all cereal crops is another important feature. All varieties presently recommended plus any newly licenced varieties that may prove of value for production in the area are tested at widely scattered locations throughout the area served by Lacombe. The results obtained from these tests permit an accurate assessment of the adaptability of any variety for production within the varied soil climatic zones of central Alberta. Brief notes on the performance of a number of varieties will appear under the heading "Variety Testing".

The maintenance of Foundation Stock Seed of a selected number of varieties in order to assure a continuous source of high quality seed for distribution to Elite Stock Seed producers is another important function of the Cereal Crops Section. Lacombe produces Foundation Stock Seed of Legacy, Eagle and Larain oats, Sanalta and Wolfe barley, and Petkus fall rye.

In addition to the above a number of special projects have been initiated in recent years that are designed to improve experimental techniques and breeding and selection techniques and procedures. Brief reference to some of this work will be made under the heading "Special Studies".

Finally, Lacombe co-operates with other institutions and agencies by conducting many miscellaneous tests that are connected with special phases of cereal crop improvement. These include national co-operative yield trials, disease trials, and tests of purity as to variety for most of the common cereal crops.

Breeding and Selection

Wheat

The Northern Wheat Breeding project involves the co-operation of the following: Cereal Crops Division, Central Experimental Farm, Ottawa; Lacombe, Beaverlodge, and Fort Vermilion Experimental Farms in Alberta; Experimental Farm, Melfort, Sask.; Laboratory of Plant Pathology, Science Service, Canada Department of Agriculture; and the Department of Plant Science University of Alberta, Edmonton, Alta; and the Grain Research Laboratory, Winnipeg, Man. The Lacombe Farm is responsible for general supervision of the project and the breeding and selection programs are conducted at both Lacombe and Beaverlodge. Other co-operating units assist with the general planning, yield testing, and screening for disease and quality.

The main objective has been to develop varieties that will mature as early or earlier than Saunders, that possess satisfactory disease reaction, good quality, and high yield. During the five-year period under review three hybrids that exhibited very high yield were developed. These had reached advanced stages of testing in the Western Co-operative Wheat Test but two were discarded because of poor quality and the third was discarded because it was not sufficiently early. However, they are valuable as parents and recently have been crossed with Reward. From the above and with further selection and back crossing it is hoped that better combinations of earliness, high yield, and other desirable characters will be found.

The frequent occurrence of early fall frosts at Lacombe has hampered the selection program in that much of the material has been rendered unsuitable for quality tests. Because of this, recent arrangements have been made for the propagation of selected material at Fort Vermilion and Lethbridge as well as at Lacombe to assure that satisfactory samples for quality tests will be available each year.

Oats

The oat breeding project is organized on a co-operative basis involving the Department of Plant Science, University of Alberta; the Laboratory of Plant Pathology, Science Service, Canada Department of Agriculture at Edmonton; and the Lacombe Experimental Farm. Lacombe is responsible for general supervision and the breeding and selection programs. The University and Plant Pathology staffs assist with general planning, disease survey work, and other related services.

The introduction of Rodney oats to central Alberta in 1954 had a marked influence on the aims of the oat breeding program. An extremely plump kernel, similar to that of Rodney has been established as one of the requisites of any new variety. The main objective, therefore, is to incorporate the plump kernel characteristic in an early maturing variety along with good yield potential and other desirable characteristics. Rodney has been used freely in the crossing program during the past three years along with Eagle and a number of promising early maturing hybrid lines.

Of special note is the apparent close relationship between early maturity and low yield. This seems to be more pronounced in oats than in other cereal crops. Because of this, some preliminary studies have been initiated with a view to more closely following the early growth pattern of early maturing, low yielding varieties like Larain compared with the late maturing, high

yielding varieties like Eagle. It is hoped that these studies may result in improved selection techniques in the effort to combine early maturity and high yield in a single variety.

Barley

In the barley breeding project the Lacombe Farm co-operates closely with the Department of Plant Science, University of Alberta, Edmonton, Alta.; the Edmonton Laboratory of Plant Pathology, Science Service, Canada Department of Agriculture; and the Malting Quality Section, Cereal Breeding Laboratory, Winnipeg, Man. Breeding and selection work is carried on at Lacombe and at the University. All co-operating units assist with the general planning. Disease screening and testing is co-ordinated by the Laboratory of Plant Pathology and quality testing is done by the Malting Quality Laboratory.

Wolfe, a selection from the cross Sanalta × Titan 2 × Montcalm × Olli is a production by this project group. It is an early maturing, lodging resistant, good yielding feed barley variety. By the fall of 1955 production of Wolfe was estimated at 500,000 bushels of pedigreed seed and 200,000 bushels of commercial seed. It is presently recommended for production in most of the soil climatic zones of central Alberta and on the irrigated land of southern Alberta.

While this variety is now grown on a considerable acreage formerly devoted to the production of Olli and some of the later maturing varieties, its use is limited in that it is not a suitable malting type. Further, it lacks good resistance to many of the diseases common to the area where it is being produced. During the last few years, therefore, more emphasis has been placed on the development of early maturing varieties that will possess better quality and more satisfactory reaction to loose smut and scald. Sources of early maturity have been Olli, Gateway, and Wolfe. Loose smut resistance was first sought from Anoidium derivatives and latterly from Brandon selections possessing the Jet type of resistance. Recently Br. 3902 and Pirrka have been used in the crossing programs for better quality.

Scald has been the cause of much concern during the past five years. It is principally a leaf disease and when it attacks plants in the early stages of growth it can cause appreciable reductions in yield and deterioration in quality of grain. In 1956 Vantmore was used in the crossing program as a source of resistance and in 1957 a number of other resistant parents were included as sources for scald resistance.

Variety Testing

Wheat Varieties

Thatcher continued to give the highest yields in all regions and the acreage devoted to this variety is much greater than for any other. Saunders, while slightly lower yielding, will mature from three to five days earlier and is more suited for production on many farms in west-central Alberta. Selkirk, under test since 1953, has shown no marked advantage over Thatcher and since stem rust is not a serious threat in central Alberta it has not been widely grown. Lake, a late maturing variety, has performed well in the eastern sections of the Brown Soil zone. Because of its late maturity its production should be confined to these regions. Rescue and Chinook, the two sawfly-resistant varieties, have given low yields when grown outside the area normally affected by the wheat stem sawfly; hence, their value to central Alberta is limited to the extreme southeastern portions of the area.

Oat Varieties

Eagle continued to rank first in yield in all regions. However, its late maturity and its comparatively small kernel are characteristics that tend to limit its use. Victory, which averages some two to three days later and is slightly lower yielding than Eagle was still widely grown in 1953, primarily because of its kernel type. In recent years, it, along with Eagle has given way to Rodney, a variety introduced into Alberta in 1954. Rodney is a plump-seeded variety that will equal Victory in yield; has better resistance to lodging, and will mature some four to five days earlier.

Larain, a very early maturing variety, which was recommended for production over a wide area in 1953, has consistently given low yields. In recent years it has proved valuable only as a special purpose crop where very early maturity is essential. Garry, while about a week later maturing than Larain, has given relatively high yields and is worthy of consideration as a variety suitable for the western and northern areas.

Barley Varieties

Newal and Montcalm, two varieties that were quite widely grown in 1953, no longer appeared on the list of recommended varieties in 1957. Newal lost favor because of its susceptibility to loose smut while Montcalm proved to be too late maturing and highly susceptible to lodging for satisfactory performance as a malting variety. Olli continues to be widely grown throughout the western and northern regions as a malting variety and for use when delayed seeding is practiced for the control of wild oats. While this variety has comparatively low yield potential, its very early maturity and the fact that Alberta's malting trade favors it, renders it a favorite with many farmers.

Vantage, a favored variety in 1953 has lost much of its popularity because of its late maturity and the fact that in some seasons its awns proved to be very persistent. Husky, Gateway, and Wolfe were added to the list of recommended varieties during the period and by 1957 a sizable acreage was devoted to the production of these varieties. Husky is a very late maturing feed barley variety with high yield potential. It has replaced Vantage to some extent. Gateway and Wolfe are relatively high yielding, early maturing feed barley varieties that are replacing Olli and some of the later maturing varieties on many farms where malting quality is not an important factor.

Flax Varieties

Redwing, an early maturing variety, continued to prove its superiority over other varieties for production on most central Alberta soils. Rocket and Redwood outyield Redwing by 15 to 20 per cent but they are 15 and 20 days later maturing, respectively. Their production is risky in any region except the southeastern portion where moisture is less plentiful and the growing season is less of a limiting factor.

Marine, Raja, and Norland, other varieties under test during the period, failed to prove superior. Marine and Raja, relatively early maturing varieties gave lower yields than Redwing while Norland, a late maturing variety, did not compare favorably with Redwood.

Fall-Seeded Crops

A limited amount of testing of varieties and strains of winter wheat and fall rye was conducted during the period under review. Kharkov 22 M.C. winter wheat continued to show its superiority, even though it lacks somewhat in winter hardiness. Petkus fall rye, a variety of German origin, proved sufficiently promising to warrant a licence in 1957. It is a large-seeded variety, less winter hardy than Dakold or Antelope, but will out-yield the latter varieties

by a considerable margin when it does survive central Alberta winters. Even with this lack of winter hardiness many rye producers favor it in preference to Dakold or Antelope.

Special Studies

Seeding Method Advances

Standard four-rod row yield plots with nine-inch spacing between rows have been sown with a self-dividing power seeding unit at Lacombe for the last six years. A power driven seeder with a gravity cone divider unit designed at Lacombe was put to use in 1952. In 1956 a change-over was made to a power machine with a spinning cone divider. This machine is a modification of the seeder designed at the University of Alberta.

Experiments in 1956 indicated that the spinning cone divider unit was as accurate in seed distribution as the single-row V-belt hand seeder. Further tests in 1957 were conducted to compare the efficiency of the gravity cone dividing unit, the spinning cone dividing unit, and the four-row V-belt hand spreading unit. Results from these tests revealed that seeds were more evenly distributed using the spinning cone divider unit than with either of the other machines.

These self dividing power plot seeders have not only effected a marked saving in time and materials in packaging seed but have proved especially valuable in seeding off-station yield tests. Without sacrificing efficiency the time required to complete seeding operations approximates 50 per cent of the time required when the four row V-belt power seeding units were in use.

Studies in Search for Selection Indexes

In all of the breeding programs at Lacombe a very high percentage of selected lines prove to be inferior in yield when they are advanced to preliminary yield trials. This result, which is by no means unique to Lacombe, has led to the initiation of detailed studies on plant growth with a view to establishing more suitable indexes which may be used in selecting for higher yield with earlier generations. Because of the marked influence of environment on such factors as tillering and number of seeds per spike, much of the work is being carried on under glass where some of the environmental factors can be controlled.

This work was initiated in 1954 and has been expanded as more information became available. While it is too early to report specific results a number of interesting leads have been established. One feature is the influence of size of seed on seedling vigor and tillering. Results from preliminary studies conducted in 1956 showed that seed designated as large produced more vigorous seedling roots than seed designated as medium and small. This work was carried on in the greenhouse using six varieties of barley.

In the spring of 1957, two seed sizes, separated by a $\frac{7}{64}$ inch x $\frac{3}{4}$ inch sieve, were used in field comparisons with three varieties. In two varieties, the large seed produced plants that possessed significantly more tillers than the plants from small seeds; in the other variety there was an increase in tillering for plants grown from large seeds, though this was not statistically significant. Subsequent greenhouse tests have provided conclusive evidence that there is a real difference in the development of the seedlings produced from seeds of different sizes. These studies indicate that differences in seed size in barley can be a major source of variation and must be taken into consideration if selection on a single-plant basis in early generations is to prove effective.

FIELD HUSBANDRY, SOILS AND AGRICULTURAL ENGINEERING

H. A. Friesen (Head), D. R. Walker and D. A. Dew

The major aspects of crop production being investigated by this section at Lacombe are soil fertility and weed control. With the appointment of an agricultural engineer in 1955, projects in this field have been initiated.

Soil Fertility

Crop Rotation Studies

Crop rotation experiments in field-scale plots have been conducted since 1911. The major comparison is the productivity of a 3-year "grain" rotation consisting of fallow, wheat, wheat with: (1) a 7-year mixed-farming rotation consisting of potatoes, wheat, oats, fallow, wheat (seeded down), hay, hay and break (manured) and (2) a 6-year "mixed-farming" rotation consisting of corn, wheat, barley (seeded down) hay, hay, hay and break (manured).

The results over the past 40 years are given by 5-year periods in Table 11 and show that the yield of wheat in the "grain" rotation has been gradually declining while in the "mixed-farming" rotations the wheat yields have tended to increase steadily. The advantage of the "mixed-farming" rotations over the "grain" rotation may be ascribed to the following three factors: (1) the beneficial effect of the grass and legume forage mixture on soil tilth and fertility; (2) the additional fertility from the manure applied once per rotation cycle at the rate of 2 tons per acre per year; and (3) the ability of this type of rotation to suppress wild oats. Unfortunately the layout of the field-scale rotations does not permit a measure of these factors independently. In order to make this assessment, an extensive project using the same rotations in replicated small plots was started in 1955.

The use of ammonium phosphate 11-48-0 at 50 pounds per acre drilled in with the seed was initiated on one half of the wheat on fallow on the 3-year grain rotation in 1933 and on the 7-year "mixed-farming" rotation in 1944. The fertilizer has given a highly profitable response on both rotations, averaging 7.5 bushels per acre on the "grain" and 7.1 on the "mixed-farming" rotation. Also, some residual effect was measured with the second wheat crop after fallow in the grain rotation.

TABLE 11.—THE AVERAGE YIELD OF WHEAT BY 5-YEAR PERIODS FROM 1918 IN THREE FIELD-SCALE CROP ROTATIONS AT LACOMBE

	Yield in bu./acre							
	1918–1922	1923–1927	1928–1932	1933–1937	1938–1942	1943–1947	1948–1952	1953–1957
"C" Wheat on fallow	30.8	30.2	25.2	18.9	20.6	25.7	27.1	28.4
"C" Wheat on fallow, fert	.....	.....	.....	24.5	31.4	36.0	40.2	36.3
"O" Wheat on fallow	37.5	25.8	31.7	27.2	39.2	42.7	36.2	44.8
"O" Wheat on fallow, fert	.....	.....	.....	.....	.....	52.9	36.3	54.6
"K" Wheat after corn	24.8	27.3	37.7	29.6	44.9	52.1	44.3	53.4
Av. precipitation (April-August)	10.04	12.37	12.18	10.97	12.21	13.29	12.16	13.03
Av. precipitation (Annual)	15.12	20.76	16.98	16.98	17.81	20.21	17.79	19.51

Rotation "C"—fallow, wheat, wheat
Rotation "O"—potatoes, wheat, oats, fallow, wheat S.D., hay, hay and break
Rotation "K"—corn, wheat, barley S.D., hay, hay, hay and break.

Chemical Fertilizers

With Grain on Fallow.—During the period under review, off-station trials were greatly expanded to more adequately assess the response of grain on fallow to various commercially formulated fertilizers as well as to different levels of nitrogen and phosphorus pentoxide (P_2O_5) on different soil types. From 1953 to 1955 the trials were conducted on 30 different soil types with commercially formulated fertilizers. In 1955 the testing of fertilizers with cereals on fallow was drawn up as a co-operative project with the Illustration Stations Division. A major change incorporated at this time was the testing of various levels of nitrogen and P_2O_5 rather than the testing of commercially prepared formulations. A factorial type of design and rod-row plots were used for this study. The test was conducted at 14 different locations in each of 1956 and 1957.

Figure 3—Effect of fertilizer on maturity and yields, no fertilizer on left yielded 53 bushels per acre and fertilized (50 lb. 11-48-0) 65 bushels per acre.

These trials reaffirmed the early findings and showed that significant yield increases resulted from P_2O_5 fertilizer drilled in with grain on fallow. With a few exceptions, there was no response to nitrogen regardless of the rate of application. To date the trials have not conclusively shown the upper limit of response to P_2O_5. In 1956 under favorable moisture conditions there was no definite levelling off up to 40 pounds per acre (the highest rate) while under drier conditions in 1957 the response tended to level off at this rate of P_2O_5.

With Grain on Stubble.—Three years of testing in co-operation with the Illustration Stations Division on seven different soil types showed that with cereals on stubble there was a greater and more consistent response to nitrogen rather than to phosphorus. In most of the trials a combination of nitrogen and phosphorus was superior to either used alone. Source of nitrogen, that is dry ammonium sulphate or ammonium nitrate or anhydrous ammonia, had no appreciable effect. Placement was important in that nitrogen at a rate in excess of 20 pounds per acre drilled in with the seed seriously delayed emergence.

Different methods of handling a heavy trash cover in conjunction with nitrogen and nitrogen-phosphorus fertilizers on deep black loam showed some advantage in favor of fall plowing over (a) fall blading, (b) fall one-way

disking, (c) chopping the straw and one-waying in the fall or (d) spring burning. One other treatment was included in this experiment, that of one-way disking in the spring, and it was the poorest in each of the three years that this test has been under way. The nitrogen-phosphorus fertilizer treatments increased the yield significantly while nitrogen alone did not.

With Hay and Pasture Crops.—Intensive studies to evaluate the fertility requirements of hay and pasture crops were not initiated until 1953. Since that time detailed field trials have been under way to assess the fertility requirements of grasses and legumes alone and in mixtures when used for both hay and pasture, on several different soil types. Other aspects under study include time of application, age of stand at time of application, split applications made in the same year, residual effect and the effect of fertility level on the winter survival of legumes.

Significant yield increases of grasses and legumes either alone or grown as mixtures for hay or pasture resulted from the application of nitrogen and phosphorous bearing fertilizers. Although the amounts of fertilizer required were at least double those required for cereals the profits from the fertilization of forage crops compared favorably with those from fertilizer used on grain. The fertilizer requirements for forage crops varied considerably with the kind of crop, moisture conditions and soil type. On deep black soils of medium-heavy texture brome alone or brome-alfalfa mixtures responded best to phosphorous or nitrogen-phosphorous bearing fertilizers applied in the ratios of 0:4 and 1:4. P_2O_5 at not less than 40 pounds per acre was found to be necessary for maximum legume yields.

Grasses on soils of lighter texture and/or lower native fertility responded profitably to 30 pounds per acre and upwards of elemental nitrogen. Brome-alfalfa mixtures on such soils also responded to nitrogen alone but much higher yield increases were realized from a fertilizer containing both nitrogen and phosphorous in the ratio of 1:1 applied at upwards of 30 lb. of the P_2O_5 per acre. On very sandy and/or badly leached soils grasses alone and grass-legume mixtures responded only to nitrogen fertilizers.

In these trials the rates of actual nitrogen ranged from 0 to 80 pounds per acre while the increments of P_2O_5 ranged up to 160 pounds per acre. Yield increases of hay and pasture varied widely with rate of application, moisture conditions, and soil type. Increases ranging from 0.5 to 2.0 tons per acre were obtained from brome-alfalfa hay on heavy black loam soil receiving 0:30 and 40:30 pounds per acre of nitrogen and P_2O_5 respectively in 1957, a rather dry season. Under above average moisture conditions the upper limit of actual crop response has not been clearly established by the rates of fertilizers used in these trials.

Phosphate fertilizers were found to greatly reduce the incidence of winter injury to alfalfa and clovers. Consequently in years when winter injury was severe as in 1955 the plots that received heavy increments of phosphate enjoyed a very distinct advantage. Residual effect on grasses has been considerable but variable.

Time of application exerted a considerable effect on the response to fertilizer. Evidence to date has shown that fall applications of nitrogen and P_2O_5 are superior to spring applications on brome grass.

Broadcasting the fertilizer on the surface for hay and pasture crops was found to be as effective as placing it 4 to 6 inches under the sod.

Hay and pasture crops are gaining rapidly in acreage and value in central Alberta and further field plot trials and laboratory studies are needed to more accurately define their fertility requirements.

Weed Control

MCPA versus 2,4-D for the control of annual weeds in grain crops.—The incidence of crop injury, notably to oats and flax, from the use of the ester of 2,4-D and the promise from preliminary trials that these crops might be much more tolerant to MCPA led to the inauguration in 1954 of an extensive co-operative project coordinated from Lacombe to compare these herbicides in oats, flax, and barley on a number of Experimental Farms in Western Canada.

On the basis of weed control and yield of grain the results of this study favor the use of MCPA over 2,4-D with either oats or flax. Oats was significantly more tolerant to MCPA, particularly if treated during the early growth stages when weed competition was most critical. With flax, the difference in tolerance was most pronounced in favor of MCPA, at the later date of treatment. The 2,4-D ester and low volatile ester resulted in a preponderance of plant deformities, lowered the yields of both oats and flax, and delayed the maturity of flax significantly. Barley yields in this study were not adversely affected by any of the treatments.

The ability of MCPA to effectively suppress the growth of hemp nettle and thereby increase the yield of oats was of special importance in the deep black soil areas of Alberta where this weed is a serious problem. The 1954 results given in Table 12 illustrate the differential control of this weed obtained with MCPA and 2,4-D.

TABLE 12.—AVERAGE WEIGHT OF WEEDS AND YIELD OF OATS FOLLOWING TREATMENT WITH VARIOUS FORMULATIONS OF MCPA AND 2, 4-D AT LACOMBE

Treatment	Date	Dry weight of weeds in pounds per acre				Yield of Oats in bushels per acre	
		Hemp Nettle		Others			
		1954	1955	1954	1955	1954	1955
MCPA	1	48	278	4	63	41.0	62.6
2, 4-D	1	478	481	4	18	36.6	45.9
MCPA	2	145	273	2	93	37.5	60.2
2, 4-D	2	312	397	.3	71	28.1	40.4
Check (untreated)		457	400	427	740	35.0	59.0

This co-operative study has been of much practical importance, particularly to the growers of oats and flax. The acceptance of these findings by the farmers in Western Canada is demonstrated by the rise in acreage sprayed with MCPA from none in 1953 to nearly 3 million acres in 1957.

Wild Oats control.—This weed is possibly the most widespread and troublesome annual weed in central Alberta. Cultural methods have met with a measure of success, notably the practice of shallow spring tillage coupled with deferred seeding of an early maturing coarse grain such as Olli barley. As shown in Table 13 this method greatly decreased the numbers of wild oats and increased the average yield of barley. The use of fertilizer further decreased the wild oats and increased the barley yield.

TABLE 13.—NUMBER OF WILD OATS CULMS AND YIELD OF OLLI BARLEY UNDER DELAYED SEEDING AND TWO LEVELS OF FERTILITY

Treatment	Fertilizer	Av. No. wild oats culms/sq. yd. 1954–57	Av. yield bu./A Barley 1954-57
Normal seeding	No fertilizer	154	36.9
Normal seeding	50 lb. 11–48–0	116	42.0
Delayed seeding	No fertilizer	46	43.0
Delayed seeding	50 lb. 11–48–0	26	48.7

The use of rotations containing forage crops, left down for several years, and early maturing varieties of coarse grains, excluding wheat, have also resulted in a decided reduction in the wild oats infestation. These methods used together, while giving a measure of suppression, do not eliminate the potential hazard, namely the vast quantities of viable seed in the soil. Therefore, the search for a herbicide to accomplish this is being prosecuted. Of the many herbicides studied only a few have shown sufficient promise to warrant more than preliminary trials.

MH (maleic hydrazide) when sprayed on wild oats, in Olli barley, during the milk stage has devitalized upwards of 90 per cent of the wild oats seeds. However, elimination of wild oats in the field by repeated dosages over a 4-year period has not been complete due to continued and sporadic germination of wild oats seed from the soil.

IPC (isopropyl-n-phenolcarbamate) has proved effective against germinating seedlings but not dormant seeds. Its high cost and the susceptibility of cereals planted the following spring have made it unsatisfactory for these crops. Randox (α-chloro-N, N-diallylacetamide) appeared very promising under Manitoba conditions in 1955 and 1956. Under Lacombe conditions the control has been highly variable. In trials on eight farmers' fields in a 50-mile radius of Lacombe in 1957 the results were negative.

The most promising herbicides presently under trial are M-757 (1,2,4,5-tetrachlorobenzene) and EPTC (ethyl N,N-di-n-propylthiolcarbamate). However, their effectiveness against dormant seeds has not been clearly established.

Tartary buckwheat.—Phenoxy-type herbicides such as the esters of 2,4-D and MCPA and the butoxy-ethanol ester of 2,4-D were tested at a number of locations during the period under review. Single and double spraying at dosages of 4 to 16 ounces per acre on tartary buckwheat in grain crops resulted in suppression of growth, notably where the butoxy-ethanol ester of 2,4-D was used but did not entirely prevent seed setting. There appeared to be only limited advantage from double spraying. In 1956 a preliminary trial with neburon (1-n-butyl-3-(3,4-dichlorophenyl-1-methylurea) showed that this herbicide gave complete kills of tartary buckwheat. Intensive field testing of neburon was undertaken in 1957.

Post-emergence applications of neburon permitted the selective control of tartary buckwheat in cereal grains. Complete kills of tartary buckwheat without injury to oats or barley were consistently obtained with not less than 3 pounds per acre of neburon applied at, or prior to, the 6-leaf stage of the weed and the grain. Under conditions of ample moisture and with treatment made prior to the 4-leaf stage of growth of the weed, highly satisfactory results were realized from the use of neburon at 2 pounds per acre. Large volumes of water, approximately 100 gallons per acre, were required for uniform application. This would constitute a most serious problem to its practical use on grain farms that have equipment adapted only for low volume spraying of 2,4-D. The cost of neburon may be a further deterrent to its farm use.

Couch Grass.—During the period under study various herbicides in combination with tillage for the control of couch grass were studied. Dalapon at ½ ounce per 100 sq. ft. gave about 90 per cent control which is the same as with TCA at four times the rate of application. Potatoes and some vegetables were not injured when planted four weeks after treatment with dalapon.

Leafy Spurge.—An infestation of this weed on cultivated land was effectively controlled by a season of intensive summer-fallow and seeding down to creeping red fescue the following year. The grass stand was sprayed with the ester of 2,4-D at 8 ounces per acre each year for four years after seeding down.

Legume Forage Crops.—Weeds present a serious problem to legume forage crops particularly in the establishment year. Trials at Lacombe showed that reasonably good control of stinkweed, mustard, and lamb's quarters could be obtained with 4 ounces per acre of the amine of MCPA without a serious set-back to alfalfa, red clover, and alsike clover. Sweet clover was severely reduced in stand by this treatment. The ester of MCPA and 2,4-D at 4 ounces per acre significantly reduced the stand of each of the legumes. Trials begun in 1957 indicated that seedling legumes were highly tolerant to 4-(2,4-DB) and these promising phenoxy-butyric formulations merit further study.

Agricultural Engineering

Tillage Studies

The effect of five basic tillage machines on soil erosion, and on trash and moisture conservation has been studied since 1955. To date no differences in yield or moisture conservation can be attributed to the different tillage machines on fallow or stubble. The Noble blade retained the most trash, with the field cultivator, one-way disk, and plow following in that order. Dry sieve analysis indicated that spring plowing resulted in a significant decrease in the percentage of erodable soil, which is considered to be all soil particles less than 0:83 mm. in diameter.

Dates of Swathing

Tests were conducted over a four-year period with Olli barley to determine the earliest stage of maturity at which this grain could be swathed without loss of test weight or yield. Plots were cut daily over a period of several days using kernel moisture content as a measure of maturity, an attempt being made to remain within the moisture range of 50 to 14.5 per cent. An analysis of the data showed that barley could be swathed at a kernel moisture content of 40 per cent without loss of bushel weight or yield. This stage is reached about a week to ten days earlier than barley is normally thought to be ready for swathing.

Silage Studies

The flywheel-type forage harvester cuts silage into shorter lengths than the recently introduced flail type. The effect of this on compaction and quality is being studied by means of laboratory silos. To date a decrease in density under the same pressures has been measured on silage produced by the flail-type harvester.

Seeding Machinery

Studies on seeding methods on fallow and stubble were initiated in 1955. The one-way seeder with and without packer was compared with the double disk press drill and with the double disk drill without press attachment. Various pre-seeding tillage treatments were used in combination with each of the seeding machines. The one-way seeder and packer after previous tillage has shown yields equivalent to those obtained with the press drill on both fallow and stubble. The one-way seeder without packer gave significantly lower yields on both fallow and stubble in all years.

FORAGE CROPS

H. B. Stelfox (deceased) and W. J. Doran

Forage crops research work at Lacombe features extensive testing of varieties, species, and mixtures of grasses and legumes for hay and pasture. In addition the seed production potential of varieties of brome grass, sweet

clover, red clover and the oilseed crops, rape and sunflower, is being investigated. At several locations introduction nurseries are maintained in which new forage species are tested in a preliminary way with standard varieties to determine their suitability to the area. Several special projects are also being conducted. A breeding program designed to develop a variety or varieties of red clover resistant to northern anthracnose and a large-scale grazing experiment are currently in progress. Most of the forage crops work is centered at Lacombe but regional tests are conducted on various Illustration Stations, the Vegreville Substation, and co-operating farms.

In the period 1953 to 1957 sharp contrasts were noted in the extent of winter damage suffered by the various forage species. Winterkilling in general, even with the hardiest species, was particularly severe during the winter of 1955-56 and provided valuable information on the relative hardiness of the various selections. On the other hand, during the winter of 1956-57 even the least hardy of grass and legume species survived with practically no damage.

Red Clover Breeding

This project, initiated in 1947 as a joint project between the Plant Pathology Laboratory at Edmonton and the Experimental Farm at Lacombe, is directed primarily toward the development of a northern anthracnose-resistant red clover variety. Excellent progress has been made toward this goal during the past five years. After testing several hundred selections for disease resistance in the field and under greenhouse conditions, three promising synthetics have finally been formed. Two of these are of Siberian origin, one consisting of seventeen individual plant selections and the other of seven. The third synthetic is formed with six resistant plants of the Dollard variety as the nucleus.

Variety and Strain Testing

Legumes

Rambler, a newly licenced creeping-rooted alfalfa variety suffered only 3.8 per cent winterkilling during 1955-56 as compared with 22.8 per cent for Grimm and 90.8 per cent for Ladak. Formerly considered as hardy as Grimm, Ladak during the past decade appears to have lost much of its inherent winter hardiness. Seed source could be largely responsible for this lack of hardiness. Where winter damage has not been a factor, Ladak has been slightly more productive of forage than Grimm.

Broadleaf bird's-foot trefoil has shown considerable promise as a suitable species for inclusion in long-term pastures. Four selections during the first crop year of 1957 produced an average of 3.29 tons of dry matter per acre as compared with an average of 1.41 tons produced by six alfalfa varieties also in the first crop year. The varieties Viking and Cascade, although starting growth earlier in the spring and making quicker recovery immediately after clipping, were significantly outyielded in total production of forage by Empire and Leofoil.

Grasses

During the five-year period ending in 1955 two northern brome grass varieties, Manchar and Martin, not only outyielded Commercial for hay but were good seed producers as well. Other promising material is being tested at the present time. Of fourteen brome grass progenies and selections developed at the Canada Agriculture Research Laboratory, Saskatoon, all but two outyielded the Commercial strain for hay during 1957, but only one, the selection S-4088, was a higher seed producer.

Standard crested wheat grass varieties during two years of testing produced on the average 2.66 tons of hay per acre as compared with 2.50 tons for varieties of the Fairway type.

Specialty Crops

Possibilities in producing non quota cash crops have prompted the testing of varieties of sunflower and rape for oilseed production.

Varieties of the Polish-type rape have proved highly productive and well adapted to the Lacombe region. During two years of testing they produced on the average 2,258 pounds of seed yearly and in all cases outyielded varieties of the Argentine type. These latter, being three weeks to one month later in maturity, were seriously damaged by early fall frosts during both years.

Late maturity of hybrids and damage by birds have been two serious hazards to the successful production of sunflowers for oil seed in central Alberta.

Perennial Hay Crops

Grass-Alfalfa Mixtures

The average yields of a number of different grasses grown alone and in combination with alfalfa for hay over a 3-year period, 1955-57, are given in Table 14.

TABLE 14.—YIELD OF DRY MATTER IN TONS PER ACRE OF SEVERAL DIFFERENT GRASSES GROWN ALONE AND IN MIXTURES WITH ALFALFA FOR HAY. (1955-1957)

Species and Strain	1957		3- year Av. (1955-57)	
	Pure Species	With Alfalfa	Pure Species	With Alfalfa
Green needle grass	1.61	1.82	2.50	2.26
S-2284 crested wheat grass	1.12	1.84	2.77	2.50
Intermediate wheat grass	.94	1.76	2.19	2.49
Summit crested wheat grass	.73	1.97	2.37	2.64
Lincoln brome	.83	1.68	1.94	2.43
Russian wild rye grass	.74	1.56	1.90	2.01
Creeping red fescue	.40	1.68	1.75	2.28
Commercial brome grass	.79	1.10	2.52	2.40
Mean	.89	1.68	2.24	2.38

Over the 3-year period the grass-alfalfa mixtures outyielded the grasses alone by only 6 per cent, whereas in 1957 they outyielded the grasses by 89 per cent. Normally the differences are not so great; however, the dry season of 1957 favored the deep feeding alfalfa over the shallow-rooted grasses. Green needle grass, S-2284 crested wheat grass and commercial brome were the only pure species which over the total period outyielded their respective mixtures with alfalfa.

Grass-Legume Mixtures for Hay

Two tests with identical species and mixtures were seeded at the Lacombe Farm and the Olds School of Agriculture in 1955. The one at Lacombe on sandy loam soil was seeded with a companion grain crop while the one at Olds located on clay loam soil was seeded without. Yield data from both tests for 1956 and 1957 are shown in Table 15.

TABLE 15.—YIELD OF DRY MATTER IN TONS PER ACRE OF GRASS AND LEGUME SPECIES ALONE AND IN VARIOUS MIXTURES FOR HAY AT LACOMBE AND OLDS, ALBERTA. (1956–1957).

Species and Mixture	Lacombe			Olds		
	1956	1957	2-year Average 1956–1957	1956	1957	2-year Average 1956–1957
Alfalfa (Ladak)	2.72	2.22	2.47	4.15	1.83	2.99
Red clover (Altaswede)	2.06	1.07	1.56	2.84	1.17	2.00
Alsike clover	1.94	.87	1.40	2.38	.47	1.42
Crested wheat grass (Summit)	2.44	2.61	2.52	2.22	.87	1.54
Brome (Manchar)	2.92	1.98	2.45	2.78	1.01	1.90
Intermediate wheat grass	2.76	1.63	2.20	2.05	.83	1.44
Timothy (Climax)	2.69	1.65	2.17	1.59	.59	1.09
Creeping red fescue (Olds)	1.90	1.52	1.71	1.33	.53	.93
Alfalfa + intermediate wheat	2.96	2.10	2.53	4.08	1.81	2.94
Alfalfa + crested wheat grass	2.59	2.29	2.44	4.49	1.87	3.18
Alfalfa + brome	2.88	1.97	2.42	4.23	2.19	3.21
Alfalfa + timothy	2.71	1.93	2.32	3.88	1.64	2.76
Sweet clover + brome	2.94	1.69	2.32	2.78	1.17	1.98
Red clover + brome	2.94	1.58	2.26	3.66	1.64	2.65
Alsike clover + brome	2.79	1.60	2.20	2.81	1.11	1.96
Alfalfa + creeping red fescue	2.44	1.80	2.12	4.29	1.70	3.00
Alfalfa + timothy + brome	2.92	1.94	2.43	4.01	1.90	2.96
Red clover + alsike + brome	2.85	1.96	2.40	4.00	1.52	2.76
Alfalfa + sweet clover + brome	2.92	1.76	2.34	3.54	1.71	2.62
Alfalfa + red clover + brome	2.79	1.75	2.27	4.17	1.71	2.94
Mean Yield	2.66	1.80	2.23	3.26	1.36	2.31

Differences in performance of the various species and mixtures at the two locations were due mainly to seeding methods and soil type.

Pasture Research

Most of the work has been on a small plot basis where plots are closely clipped several times during the season to simulate grazing. Results to date from a large grazing experiment using Hereford steers and comparing three pasture mixtures under three fertility levels are included in the Animal Husbandry Section of this report.

Grass-Alfalfa Pasture Mixtures

Of fourteen grass species seeded alone and in mixture with alfalfa in 1955 two drought-tolerant species, big bluegrass and green needle grass were the most productive of forage during 1956 and 1957. They produced on the average 2,602 and 2,688 pounds of dry matter per year respectively as compared with 2,231 pounds for Manchar brome. Creeping red fescue, timothy, and Kentucky bluegrass have been extremely low producers under the below normal moisture conditions of the past few years. The yield benefit resulting from inclusion of alfalfa and noticeable in older stands has not yet shown in this test.

Grass-Legume Pasture Mixtures

In another test established in 1955 the yield potential for pasture of alfalfa, red clover, alsike, trefoil, and Common White Dutch clover in mixtures with brome, timothy, and fescue was compared. Over the 2-year period the various legumes in mixture with brome outyielded the same species in mixture with timothy by 27 per cent. The brome-alfalfa-fescue mixture gave a yearly average production of 2,422 pounds of dry matter per acre as compared with 1,858 pounds for the timothy-alfalfa-fescue mixture. The brome-alfalfa-timothy mixture was no more productive than either the brome-alfalfa or the timothy-alfalfa mixture.

Renovation of Permanent Pasture

In the spring of 1953 thirteen renovation and reseeding treatments were applied to a permanent pasture of brome and Kentucky bluegrass on light sandy loam at Lacombe. Manure and fertilizer treatments were re-applied in the spring of 1955. The test was harvested only once during 1953 but twice in each of the three succeeding years. Yield data over the 4-year period has provided some useful information.

The importance of fertilizer, either commercial fertilizer or manure, in rejuvenating permanent pasture has been well demonstrated. Where applications of manure at 15 tons per acre and A.P. 16-20-0 at 200 pounds per acre were applied twice in four years, herbage production over the 4-year period was increased by 70 and 79 per cent respectively. Tillage alone, with disk harrow, tool bar cultivator or one-way did nothing to improve the unfertilized pasture. Likewise, one-waying and reseeding without applying fertilizer or manure did not increase production. However, the combination of tillage, fertilizer application, and reseeding with a mixture of 4 pounds brome, 3 pounds creeping red fescue, and 3 pounds alfalfa per acre resulted in the greatest improvement with an increase of 105 per cent over the untreated pasture.

Plowing, working down, and seeding immediately to the pasture mixture and a companion crop of oats gave a substantial crop of oat hay the year of seeding but little improvement in forage yield in succeeding years. Likewise, seeding to the pasture mixture without the companion crop and without fertilizer maintained production at a high level for only a 2-year period after which yields fell off sharply.

Seed Production

Effect of Fertilizer on Seed Production of Creeping Red Fescue

On the basis of experiments conducted on ten farms in the central Alberta region during the 3-year period, 1954-56, the most economical returns from the seed production standpoint have been obtained from the application of 100 to 200 pounds per acre of ammonium nitrate and from 200 pounds per acre of ammonium phosphate 16-20. The effectiveness of the particular fertilizer treatment has been dependent upon the soil type, moisture conditions, and other factors. For forage production, ammonium nitrate has given the most economical returns.

HORTICULTURE

H. T. Allen

The construction of many new homes and the interest in farm home improvement has caused a considerable increase in horticulture in both urban and rural areas. Variety testing remains an important phase of the work at Lacombe but many other problems, that have a wide common interest, are being studied on a regional and national basis, in special co-operative projects.

Vegetables

Variety Trials

Some 338 different varieties of vegetables were grown in variety comparison trials, the results of which are used for the recommendations as published in the Alberta Horticultural Guide.

Tomato Breeding

The tomato breeding program begun in 1948 to develop a suitable variety for central Alberta was terminated in 1955 in favor of a co-operative program between several experimental farms in the three Prairie Provinces and Northwest Territories. In the early stages of the initial program the pedigree system of breeding was used and centered around the early varieties Farthest North and Redskin. The most desirable progeny were obtained from Farthest North × Early Chatham and Redskin × Bison crosses. In the former instance it was found that earliness was associated with small fruit size which led to a series of backcrosses to increase fruit size using Early Chatham as the recurrent parent. No introductions have been made to date from this program but seven selections are currently being investigated in yield trials in comparison with several standard varieties.

In 1952-53 the facilities of the Lacombe Farm were used to provide seed for other institutions from specified crosses in a small co-operative pedigree breeding program, but this too was terminated in 1955 in favor of the larger co-operative arrangement.

As part of the Prairie Co-operative Tomato Breeding Program the Lacombe Farm is investigating backcross lines from (Earlinorth × Morden BB3) × Earlinorth.

Dates of Seeding Tomatoes.—In two years out of three seeding tomatoes in the greenhouse on April 5 has given significantly higher yields of ripe fruit than seeding 10 days earlier or later than this date. Plants seeded on March 27 or as early as March 17 tend to become leggy and are in bloom with some fruit set at planting time. They have produced early maturing fruit but total yields have been poor.

Spraying Tomato Blossoms for Early Fruit Set.—Spraying tomato blossoms with commercial hormone preparations for the purpose of initiating fruit set under adverse weather conditions has not been successful in producing significantly higher yields of ripe fruit in the Early Chatham variety.

Dates of Seeding Onions

Seeding onions in the greenhouse as early as March 20 has produced early maturity in some varieties, and was superior to commercial transplants and sets in 1957. Excellent results have been obtained with Autumn Spice; fair results with Brigham Yellow Globe, Early Yellow Globe, Large Red Wethersfield, and Yellow Globe Danvers; but poor results with Giant Prizetaker and Riverside Sweet Spanish.

Potato Trials

The primary object of potato investigations at Lacombe is to find an early, shallow-eyed, scab-resistant variety to replace the Warba. Toward this end, some 217 varieties and selected seedlings were tested under the National Potato Variety and Seedling Trials in the period 1953-1957. The more promising seedlings and varieties are advanced to replicated yield trials in comparison with standard varieties. Dry matter content is used as an indication of quality and tubers below 15 per cent are considered to possess poor, and those over 18 per cent, good quality.

Yield and dry matter data for nine varieties are given in Table 16.

TABLE 16.—YIELD IN BUSHELS PER ACRE AND PERCENTAGE DRY MATTER CONTENT OF NINE POTATO VARIETIES

Variety	Number Years of Yield Data	Av. yield Bushels per Acre	Av. Dry Matter %
Pontiac	2	798	14.2
Cherokee	2	652	17.3
Warba	3	649	15.7
Keswick	3	647	17.3
Columbia Russett	3	644	17.6
Canus	3	623	15.2
Canso	3	559	17.0
Netted Gem	3	523	18.2
Early Gem	2	414	15.0

Chemical Weed Control in Vegetable Crops

Weed control with herbicides in vegetable crops is not practical for the average gardener but it has commercial possibilities. The treatments listed have been found to be of value in the control of the annual weeds shepherd's purse, Lamb's quarters, and stinkweed.

Carrots.—The dry-cleaning fluid "Varsol" at the rate of 80 gallons per acre sprayed on carrots at the two true leaf stage has given good weed control without injuring the carrots.

Corn.—The amine salt of 2,4-dichlorophenoxy-acetic acid applied as a pre-emergence spray at 1 pound acid equivalent per acre six days after seeding, or as a post-emergence spray at 0.5 pounds acid equivalent per acre when the corn is 8 inches high is effective.

Peas.—Best results have been obtained by spraying the peas when they were 4 inches in height with Dow Selective (ammonium dinitrosec-butylphenate 13.7 per cent) at the rate of 3 quarts in 100 gallons of water per acre.

Onions.—Aero Cyanamid Special Grade at 100 pounds per acre applied immediately after seeding has given good weed control, but for a 4-week period only.

Rutabagas.—Trichloroacetic Acid at 40 pounds per acre as a pre-planting treatment applied 6 days prior to seeding was effective in controlling weeds for a 6- to 8-week period.

Tree Fruits

Variety Trials

The fireblight disease has been one of the major limiting factors in the apple and crabapple variety testing program, as a considerable number of trees have been lost before reaching fruiting age. Attempts to control this disease have not been successful. The varieties that have become established and have proved to be hardy are few and include the following:

Apples—Heyer 12
Crabapples—Dolgo, Beauty, Sylvia
Apple-Crabapple Hybrid—Rescue
Plums—Dandy
Sandcherry—Plum Hybrids—Dura, Sapa
Pears—Pyrus ussuriensis.

Fruit Breeding

Apple-Crabapples.—A total of 6,518 seedlings from twenty-two controlled apple and crabapple crosses originating at the Experimental Farm, Morden, Man., and under the Prairie Cooperative Fruit Breeding Program, were set

out in 1954-55. After two winters, hardiness ratings showed that 77.7 per cent of the seedlings suffered more than 50 per cent winter injury. The crosses that produced progeny of the greatest hardiness were Osman × Dr. Bill, Columbia × Dr. Bill and Heyer 12 × Dr. Bill.

Prunus fruticosa.—In an attempt to produce a hardy, productive, and good quality variety of this sour cherry 1,300 seedlings were set out for observation in 1953. To date, these seedlings have proved to be almost 100 per cent hardy, so that the main basis for selection will be fruit characteristics.

Prunus tomentosa.—Variety tests with this sweet cherry have shown that present varieties are not reliable as to hardiness or fruiting ability in the Lacombe area. A breeding program was begun in 1949 from seed obtained from a local source. The first selections were made in 1953 and from the original number of 450, seven are presently being investigated.

Small Fruits

Variety Trials

Varieties of small fruits that have given the best results during the past five years are:

Strawberries—Dakota, Glenmore, Brilliant
Gooseberries—Abundance, Pixwell
Currants: Black—Consort
Red—Greenfield, Pamona
White—Large White, White Grape

Raspberries.—Winter injury in the red raspberries has been severe in most seasons and has directly influenced yields. The recommended practice of covering the tips with soil so that canes might be covered with snow has not been too successful in decreasing the amount of injury, as in many seasons snow cover has not been sufficient to protect the bent portion of the cane and winter injury has therefore been as severe in these instances as that to the exposed canes. The 9-year average of results shows that for covered canes winter injury has ranged from a low of 30.6 per cent for Gatineau to a high of 79.4 per cent for Newburgh. For exposed canes the range has been from 40.3 per cent for Honeyking to 83.3 per cent for Newburgh. Winter hardiness is the most important characteristic for raspberries in the Lacombe area and although Honeyking, Ruddy, Starlight, and Sugar King lack in fruit quality they have proved to be the hardiest during the past five years.

Black and purple raspberries have proved to be too tender to be satisfactory although they can be grown if the canes are completely covered with soil in the fall.

The variety Indian Summer, an everbearing type, produced a light fall crop in 1957 but fall production is generally too late to be satisfactory.

Breeding

Strawberries.—Seed from thirteen controlled strawberry crosses was received from Morden in 1954 and the resulting plants were set out for observation in 1955. From these, 16 individual selections are presently receiving attention, the most promising being from the crosses: Valentine × Simonet No. 18, Pixie × Premier, Pixie × Evermore, and Pixie × WA21.

Raspberries.—Seed from thirteen controlled raspberry crosses, each of which had Honeyking as one of the parents, was received from Morden in 1954 and the plants set out for observation in 1955. In this program, hardiness is the main characteristic being considered, but selection is being made for

disease resistance and fruit quality. To date, the progeny from Latham × Honeyking has shown the least hardiness while Honeyking × Ottawa has given the highest percentage of hardy seedlings. Honeyking × Muskoka has been relatively high in susceptibility to powdery mildew.

Ornamentals

Effect of Well Water on some Annual Flowers

Well water as supplied by the town of Lacombe is highly alkaline due to bicarbonate of soda at 490 ppm and pH 8.5. It is not possible to grow Salvia in the greenhouse using well water but this plant can be grown successfully with snow or rain water. Other plants that are affected but to a lesser extent are: geraniums, pansies, phlox, nemesia, and verbena.

Variety Tests

Rather extensive variety lists are contained in the Alberta Horticultural Guide and only those ornamentals that are relatively new, or have been quite outstanding during the last five years are listed here.

Herbaceous Perennials.—Little Blue Boy Aster, Prairie Gold, and Morden Gold Chrysanthemums, *Campanula glomerata, Geranium ibericum.*

Hedges.—Manchurian Elm, *Ulmus pumila;* Cerro Hawthorne, *Crataegus cerronis.*

Deciduous Trees and Shrubs—Cornus alba var. argentea marginata; Redwine and Nocturne lilacs; Korean larch, *Larix Gmelini japonica;* Griffin Poplar.

Evergreens.—Swiss Stone Pine, *Pinus cembra;* Creeping Juniper, *Juniperus horizontalis;* Savin Juniper, *Juniperus sabina;* Rocky Mountain Juniper, *Juniperus scopulorum;* Swiss Mountain Pine, *Pinus mugo;* Wares Arborvitae, *Thuja occidentalis* var. *robusta.*

ILLUSTRATION STATIONS

L. J. Anderson and S. R. Church

Illustration Stations are privately owned farms operated in co-operation with the Experimental Farms Service. Stations closed during the period of this report include Ryley in 1955 and Chauvin in 1957. A new station was opened at Acme in 1953. Details pertaining to stations operating in 1957 are given in Table 17.

TABLE 17.—LOCATION OF STATIONS, NAMES OF OPERATORS, SOIL ZONE AND SOIL TYPE

Stations	Operators	Soil Zone	Soil Type
Acme	R. W. Brown	Dark Brown	Loam (Not classified)
Castor	F. M. Pals	Dark Brown	Halkirk loam
Metiskow	E. Masson	Dark Brown	Metisko fine sandy loam
St. Paul	J. R. LaFrance	Black	Angus ridge loam
Bonnyville	W. G. Levasseur	Black	Angus ridge loam
Chedderville	H. Williams	Gray Wooded	Caroline silt loam
Leslieville	G. N. Lynn	Gray Wooded	Raven silty clay loam + sedge peat
Evansburg	R. Weist & Sons	Gray Wooded	Magnolia silty clay loam
Athabasca	J. Eherer	Gray Wooded	Breton loam

Rotation Studies

All stations carry at least one mixed farm rotation which is designed to fit in well with the type of farming being practiced. The type of rotation varies considerably depending on the need for feed for livestock, cash crops, control of weeds or soil erosion, and maintenance of soil fertility. Without exception, the combined use of mixed farm rotations and suitable fertilizing practices were found to be more suitable than either method used alone. At some locations comparisons were made between types of rotations.

In the Dark Brown soil zone fallow-grain or fallow-grain-grain rotations were used more extensively than mixed farm rotations. Soil fertility was maintained either by the use of sweet clover as a green manure crop during the fallow year or by seeding down one field to a grass-legume mixture for a few years while the remaining fields were rotated on a two- or three-year grain rotation basis. In all cases where hay was grown, grass-legume mixtures were more productive than grasses grown alone or in mixture with one another. Some difficulty was experienced in establishing forage crop stands in years of low moisture.

In the Black and Gray Wooded soil zones mixed farm rotations of various durations were used almost exclusively. In these areas, no difficulty was experienced in establishing forage crop stands by seeding with a nurse crop. In fact, seeding with a nurse crop was very desirable on Gray Wooded soils to prevent crusting.

During the period 1951-56, inclusive, a comparison between three rotations was made at Chedderville. The results during the first cycle of the rotations (Table 18) emphasize the economic advantage of a mixed farm rotation over a straight grain rotation in this area.

TABLE 18.—COMPARISON OF ROTATIONS AT CHEDDERVILLE—1951-56 INCLUSIVE

Rotation No.	Cropping Sequence	Gross Returns per acre	Cost of Production per acre	Net Returns per acre
		$	$	$
1.	Alternate grain and sweet clover green manured	14.41	16.95	−2.54
2.	Grain, sweet clover green manured, grain and 3 years hay	23.23	15.34	7.89
3.	Two years grain and four years hay	23.63	14.05	9.58

Fertilizer Studies

In fertilizer trials, in combination with a fallow-wheat-oats and a fallow-wheat-legume hay rotation, conducted on Gray Wooded soil at Chedderville and Athabasca, wheat in the legume rotation outyielded wheat in the grain rotation. Similarly, substantial increases in grain and hay yields were obtained from use of sulphur-bearing fertilizers or manure. The response to fertilizers was more pronounced on the hay than on the grain crops. In addition it was noted that the legume crop aided in the control of weeds and made the soil more friable and less subject to baking.

Fertilizer trials on reed canary grass grown on peat soil at Leslieville showed that the highest yield increases and residual effects were obtained from manure, followed by fertilizers containing a combination of nitrogen, phosphorous, and sulphur. Yields increased with increased rates of fertilizer in each case. The addition of potassium had a slight beneficial effect when applied directly but there was no residual response from it.

In a three-year fallow—wheat—wheat rotation conducted on loam soil at Acme from 1954 to 1957, yields of wheat after fallow averaged 41.0 bushels per acre when manure was applied at 15 tons per acre and 39.2 bushels per acre when fertilized with ammonium phosphate 11-48-0 at 25 pounds per acre compared with 27.5 bushels per acre where no fertilizer was applied. The residual effects measured by yields on the second wheat crop were 31.6, 27.7, and 23.2 bushels per acre for manure, ammonium phosphate 11-48-0, and the check, respectively.

On fine sandy loam soil at Metiskow, wheat after fallow fertilized with ammonium phosphate 11-48-0 at 30 pounds per acre yielded an average of 31.4 bushels per acre compared with 25.6 bushels per acre where no fertilizer was used during the 4-year period, 1954-57. This represented an increase of 5.8 bushels per acre in favor of the fertilizer or a net profit of $4.30 per acre based on wheat at $1.00 per bushel and fertilizer at five cents per pound.

Comparison of Cultural Treatments

Two tests on methods of seeding wheat on fallow on light sandy soil at Metiskow for three and four years, respectively, gave the following results:

(1) Noble drill—31.4 bushels per acre versus one-way seeder and packer—31.7 bushels per acre.

(2) Noble drill—29.2 bushels per acre versus press drill—30.7 bushels per acre.

There was very little difference in yield but the cost of seeding with the Noble drill was much higher than with the press drill or with the one-way seeder and packer.

Yield data from three methods of seeding wheat on fallow and on stubble at Acme (Table 19) indicate a slight advantage in favor of the one-way seeder and packer over the one-way—press drill or the cultivator—press drill combinations. Moisture conditions during the testing period were higher than average which may have affected the results to some extent.

TABLE 19.—COMPARISON OF SEEDING METHODS AT ACME—1954-57, INCLUSIVE

Methods of Seeding	4-year Average Wheat Yields	
	Fallow	Stubble
	Bu. per Acre	Bu. per Acre
One-way seeder and packer	41.6	24.9
One-way and press drill	40.4	23.6
Cultivator and press drill	39.8	23.0

Cereals

Cereal varieties introduced on the stations during the period under review include Saunders and Lake wheat; Eagle, Rodney, and Beaver oats; and Vantage, Husky, Parkland, Wolfe, and Gateway barley. Seed distributed during this period included 10,926 bushels wheat; 20,227 bushels oats; 11,591 bushels barley; and 30 bushels flax.

Forage Crops

Forage species and varieties introduced on the stations in recent years include Ladak alfalfa, creeping red fescue, Summit crested wheat grass, Russian wild rye, and intermediate wheat grass. Alfalfa, sweet clover and brome are the most widely adapted forage species and are grown extensively in all soil zones. Crested wheat grass, Russian wild rye and intermediate wheat grass are adapted to the Dark Brown soil zone where drought resistance is important. Creeping red fescue and intermediate wheat grass are well adapted to the Black soil zone, whereas timothy, creeping red fescue, alsike, and red clover are better suited to the moist regions in the transitional and Gray Wooded soil zones. Reed canary grass is particularly well suited for areas subject to long periods of flooding. Slender wheat grass, tall wheat grass and sweet clover are adapted to alkali areas.

Pasture Investigations

An experiment with seeded pastures was conducted on Gray Wooded soil at Athabasca from 1954-57 inclusive. Dairy cattle were used for grazing. Summary yields for the 3-year period 1955-57 are given in Table 20.

TABLE 20.—THREE-YEAR AVERAGE YIELDS OF FORAGE—ATHABASCA, 1955-57

Grass Species	Pounds per Acre of Dry Matter			
	Grass alone	Grass Mixture with		Average
		Bird's-foot Trefoil	Alfalfa	
	lb.	lb.	lb.	lb.
Timothy	1310	1248	2012	1523
Brome grass	1262	1235	1898	1465
Intermediate wheat grass	1256	1188	1897	1447
Creeping red fescue	776	757	1219	917
Russian wild rye	581	786	1123	830

Mixtures of the grasses with alfalfa were much more productive than the grasses alone or in combination with bird's-foot trefoil. Brome was least affected by winter crown rot, winter injury or varying precipitation, and thus provided the most uniform production over the 3-year period and was second only to timothy in total production. Timothy provided a greater amount of pasture herbage in the year following seeding than in subsequent years. It was particularly palatable to the animals. Intermediate wheat grass yielded well but was not grazed as closely as brome or timothy because of its somewhat coarse herbage. Brome, timothy, and creeping red fescue were better able to compete with weeds than were Russian wild rye and intermediate wheat grass.

Farm Business Studies

The sources of revenue for the stations under study are presented graphically by soil zones.

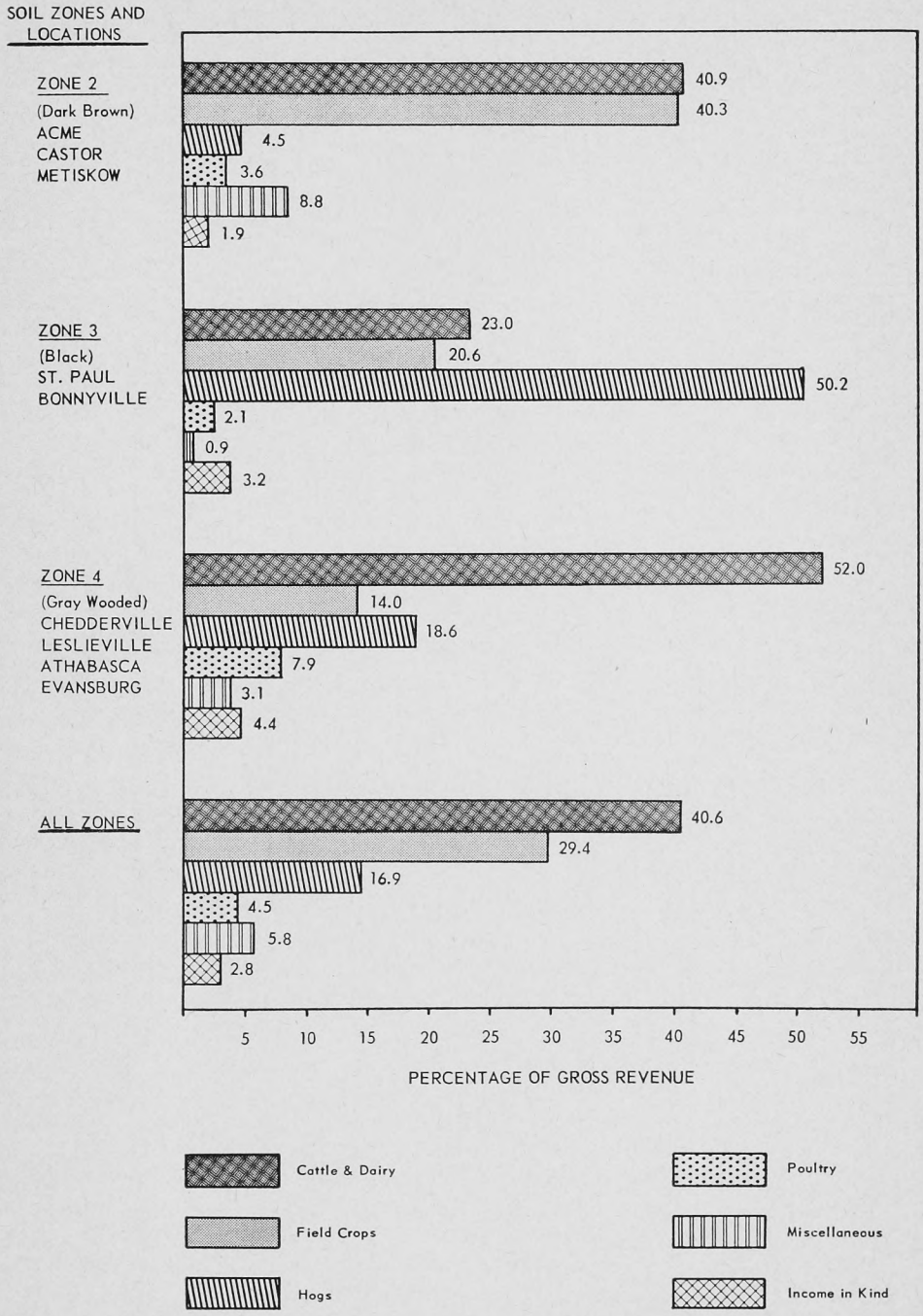

Figure 4—Sources of revenue, 1954-1957, for the stations.

In all zones the revenue from livestock (hogs and cattle) was highest. Field crops were approximately 90 per cent of the value of livestock on the Dark Brown soil stations, 30 per cent in the Black soil, and only 20 per cent on the Gray Wooded soil. The stations in the Black soil zone obtained one-half of their revenue from hogs while those in the Gray Wooded soil zone received approximately the same amount from cattle.

The cost of summerfallowing in 1956 and 1957 ranged from $4.62 to $12.40 per acre.

In 1956 and 1957 the average yields of wheat ranged from 16.6 to 55.2 bushels per acre; oats from 25.5 to 97.5 bushels per acre, and barley from 44.2 to 80.0 bushels per acre. During the same period the cost per bushel for wheat ranged from $0.49 to $0.94; oats from $0.32 to $0.67, and barley from $0.33 to $0.74.

Average farm size was much greater on the Dark Brown soil stations than on the Black or Gray Wooded. Native pasture comprised 45.8 per cent of the total acreage on the Dark Brown soil stations while cropped land made up 48.4 per cent. On the Black and Gray Wooded stations cropped acreages were 73.7 per cent and 66.7 per cent, respectively, of the total acreage with only minor acreages in native pasture. Of the cropped land on the Dark Brown stations 26.1 per cent was fallowed while 16.1 and 11.4 per cent, respectively, was in fallow on the Black and Gray Wooded. On the stations under study in the Black soil zone, 59.9 per cent of the cropped land was in grain with only 16.4 per cent in hay or forage crops whereas on the Gray Wooded stations grain and hay crops were about evenly divided comprising 34.9 per cent and 36.1 per cent, respectively, of the total acreage.

The average capital investment, capital investment per cropland acre, and gross revenue per cropland acre for the stations under review are given in Table 20.

TABLE 20.—CAPITAL INVESTMENT, CAPITAL INVESTMENT PER CROPLAND ACRE, AND GROSS REVENUE PER CROPLAND ACRE ON ILLUSTRATION STATIONS IN CENTRAL ALBERTA

Zone and Station		Land and Buildings 1953–57	Livestock 1953–57	Machinery and Equipment 1953–57	Investment per acre of Cropland 1953–57	Gross Revenue per acre of Cropland 1953–57
		Percentage of total	Percentage of total	Percentage of total	Dollars	Dollars
Zone 2 (Dark Brown)	Castor	42.8	22.8	34.4	42	14
	Metiskow	29.1	25.7	45.2	53	14
	Acme	44.5	17.2	38.3	44	24
Average		38.8	21.9	39.3	47	17
Zone 3 (Black)	Bonnyville	57.3	7.1	35.6	115	27
	St. Paul	47.2	29.5	23.3	133	32
Average		52.2	18.3	29.4	124	29
Zone 4 (Gray Wooded)	Chedderville	36.0	22.1	41.9	131	30
	Leslieville	52.8	8.8	38.4	59	6
	Athabasca	42.0	23.3	34.7	90	27
	Evansburg	53.2	15.9	30.9	136	27
Average		46.0	17.5	36.5	104	23

EXPERIMENTAL SUBSTATION—VEGREVILLE

R. R. Cairns

Solonetzic Soils Research

To investigate one of the major soil problems of Western Canada, that of solonetzic soils, an experimental Substation was established at Vegreville, Alberta, in 1955. These soils developed under saline conditions, where sodium and magnesium constituted an appreciable portion of the salt content. In the process of development they acquired a compact, impervious B horizon which occurs at various depths and, where close to the surface, seriously disturbs soil moisture relationships and drastically reduces crop productivity. There are several million acres of solonetzic soils already mapped in Canada. They occur in all soil zones in the Prairie Provinces.

Tillage and Amendment Studies

Russian workers have suggested two methods of improving these soils, namely, deep plowing, and the application of gypsum. These methods are basically the same—in the deep plowing method the native calcium is elevated and mixed with the surface soil, while in the other method calcium is applied directly. Both are based on the replacement of exchangeable sodium and magnesium by calcium. These methods, and modifications of them are under study at Vegreville. One of the main modifications is chiseling to allow the penetration of crop roots to the supply of native calcium. Other modifications under study are the incorporation of amendments such as straw, manure, soil conditioners, vermiculite, and other materials to various depths in the soil.

Where the soil had been chiseled in the spring of 1956 and grew a sweet clover crop in 1957, the treatment had a marked effect on the clover in spite of severe drought conditions. The average yield of sweet clover taken in square yards over the chisel marks was 1,291 pounds dry hay per acre, while between the chisel marks it was 645 pounds per acre. The yield and chemical analysis of the sweet clover sampled from each area is presented in Table 21.

TABLE 21.—AVERAGE YIELD AND CHEMICAL COMPOSITION OF SWEET CLOVER GROWN OVER AND BETWEEN CHISEL MARKS ON SOLONETZIC SOIL—1957

	Lb./acre						
	Dry Hay	N %	P %	K %	Ca %	Mg %	S %
Between Chisel Marks	645	2.99	.28	2.14	.88	2.60	.77
Over Chisel Marks	1291	3.30	.20	2.11	.94	1.36	.54

The percentage content of nitrogen, phosphorus, potassium, and calcium were fairly similar in the better and poorer crops, and thus the total plant uptake was relatively in proportion to yield. However, the magnesium and sulphur contents fell markedly in the better crop.

Soil Permeability

Studies are in progress on the water permeability of the various soil horizons, and the penetration and distribution of water within the soils at Vegreville in relation to the productivity and chemical and physical characteristics of the various soil types. The permeability of undisturbed cores of the Daugh (solonetz), Shallow Wetaskiwin (solodized solonetz) and Malmo

(thin black) soil types was measured through a period of 76 days. A constant, 2-inch, head of water was maintained on 4-inch cores procured from the B and C horizons of these soils. While the B horizon of the Malmo soil did percolate slightly more water, (approximately 2.0 ml/hour) than the other two soils, (approximately 0.1 to 0.2 ml/hour), the great difference was in the C horizon. The C horizon of the Malmo soil percolated approximately 15.0 ml/hour as compared with about 0.2 to 0.4 ml/hour for the other two soils. Some refinement will be required in this technique to obtain a measure of small differences.

With respect to salt distribution only preliminary work has been undertaken.

Crop Adaptation

Of the many species under test in the forage observation nursery in 1957, rape was the most productive. Two crops of rape were removed with an approximate yield of 25 tons of green material per acre. No other species grew well on the unproductive soil area on which the test was established. Moisture conditions were poor in 1957.

PUBLICATIONS

Research Papers

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Friesen, H. A., and D. R. Walker. A comparison of MCPA and 2,4-D for the control of annual weeds in grain. Can. J. Pl. Sci. 37:1, 69-81. 1956.

Stelfox, H. B., D. H. Heinrichs, and R. P. Knowles. Seed production studies with Russian wild-rye. Can. J. Agr. Sci. 34:28-35. 1954.

Miscellaneous Papers

Doran, W. J. The effect of harvesting practices on yield and winter survival of alfalfa in central Alberta. Agr. Inst. Rev. 10(3) 39. 1955.

Stelfox, H. B. and W. J. Doran. Two types of cages found satisfactory for pasture studies. J. Range Mgnt. 10:15, 230-231. 1957.

Stothart, J. G., and H. T. Fredeen. A new breed of bacon hogs for Canada. Agr. Inst. Rev. 10:4; 11-13. 1955.

Walker, D. R., Fertilizer applications on alfalfa-brome hay mixtures. Agr. Inst. Rev. 10.40. 1955.

Bulletins and Pamphlets

Fredeen, H. T. Genetic aspects of Canadian bacon production. Can. Dept. of Agr. Pub. 889. 1953.

Wilson, H. E., J. G. Stothart and G. E. DeLong. Swine Production. Can Dept. of Agr. Pub. 686. 3rd ed. 1954, in French 1955.

Research Highlights—Lacombe (processed). 1952, 1953, 1955, 1956, 1957.

Crop production and yields in central Alberta (processed) 1954.

The Lacombe breed. (Pamphlet) 1957.

Lacombe's 50th Anniversary (booklet) 1957.

Through the Alberta Provincial Advisory Committees on Fertilizers, Forage Crops, Horticulture, and Varietal Zonation, contributions have been made to the following Alberta Department of Agriculture publications:

Alberta Horticultural Guide—1954, 1956, 1958.
Fertilizers in Alberta—1954, 1956.
Varieties of Grain for Alberta. 1953, 1954, 1955, 1956, 1957.
Grass and legume seed crops for Alberta, 1954.
Hay and pasture mixtures for Alberta. 1956.

Conference and Committee Papers

During 1953-1957 the Lacombe Experimental Farm Staff has contributed to the following:

Proc. Assoc. Comm. Pl. Breeding	2 papers
Proc. Can. Soc. Anim. Prod.	6 papers
Proc. N. Gent. Weed Cont. Conf.	3 papers
Proc. West. Can. Soc. Agron.	1 paper
Proc. West. Can. Soc. Hort.	2 papers
Proc. West. Can. Weed Cont. Conf.	4 papers
Proc. West. Forage Crops Conf.	6 papers

Research findings were also released through news and feature articles, radio and television interviews, and addresses at field days and meetings.